

DEVICE FOR COUPLING TOGETHER Laterally Directed Scaffold Elements and Uprights in a Scaffold or the Like

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Inventor: WALLTHER KJELL H A
Applicant: WALLTHER ENG AB
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Abstract of CA1194059

A device for coupling together laterally directed scaffold elements and uprights in a scaffold or the like. Each coupling device includes an engagement member which is connected to the upright and is open upwards at least in the position of use. Said member is provided with a wall which extends with spacing from the upright and which delimits a space situated between the upright and the wall. A hook-up member is situated at least at one end of each scaffold element and is adapted to hook into the engagement member. A first clamping member is movable in relation to the scaffold element and is adapted to bear against the upright and against the engagement member. A second clamping member is adapted, in a locking position to be forcibly gripped between the respective first clamping member and the respective scaffold element. The clamping member is pressed towards the upright and the scaffold element is pressed in the direction out from the upright and as a result is clamped by means of the hook up member in the engagement member. The second clamping member can consist of two differently shaped wedges which enable adjustment between different transverse directions of the uprights. The invention produces an improved strength of the coupling.

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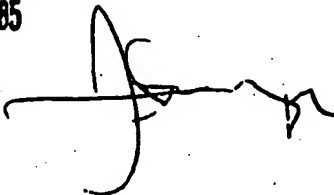
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(19) (CA) **CANADIAN PATENT** (12)

(54) Device for Coupling Together Laterally Directed
Scaffold Elements and Uprights in a Scaffold or the
Like

(72) Wallther, Kjell H.A.,
Sweden

(73) Granted to Wallther Engineering Aktiebolag
Sweden

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The present invention relates to a device for coupling together scaffold elements and uprights in a scaffold or the like.


A common type of known coupling devices comprises besides an engagement member on the upright and a hook-up on the end of the laterally directed scaffold element merely one clamping member in the form of for example a wedge. This type does not establish any stiff connection between connected members resulting in that the scaffold in many cases will be unstable.

Another disadvantage is present in connection with the wedge shaped members which are utilized for clamping coupling devices to an upright. The wedge shaped member is inserted into a space so that a coupling member is pressed either against the upright or against a wall included in a member which is fixed to the upright. However, among scaffolds different cross dimensions are present at the uprights. This involves general different relationships in positions of the members disclosed in the coupling device. This results in that the wedge shaped member must be dimensioned with a disadvantageously large size in order to enable an adjustment to the different dimensions. This involves that the wedge shaped member projects from the coupling device and can be an obstruction for support elements to be placed on the lateral scaffold elements.

An object of the present invention is to eliminate the above-mentioned disadvantage in known coupling devices and to provide a device which establishes a substantially rigid connection which can be released in a simple way.

Another object of the present invention is to enable on one hand coupling of a transverse scaffold element to an upright in an arbitrary direction out from the upright and on the other hand a coupling together or disconnection independent of other transverse scaffold elements.

Another object of the present invention is to enable an adjustment to different cross dimensions of the uprights without having the wedge shaped member projecting upwards in a disadvantageous way.



In general terms, the present invention provides scaffold means comprising a coupling device for coupling together a laterally directed scaffold element to an upright, wherein the coupling device includes an engagement member which in use is connected to the upright and is open upwards, said engagement member comprising a wall which extends with spacing from the upright and which delimits a space situated between the upright and the wall, a hood member disposed at least at one end of the scaffold element and adapted to hook into the engagement member, a first clamping member which is movable in relation to the scaffold element and the hook member and which comprises one or more clamping surfaces, said first clamping member being arranged so that in use at least one of its clamping surfaces bears against the upright, and a second clamping member which is adjustable between a release position and a locking position and which is adapted, in the locking position, to be forcibly gripped between the first clamping member and the scaffold element so that the first clamping member is pressed towards the upright and the scaffold element is pressed generally horizontally away from the upright whereby the scaffold element is clamped by means of the hook-up member to the engagement member.

In a preferred embodiment, the scaffold element comprises a transverse slot and the second clamping member consists of a wedge member which is adapted to be introduced into the slot in the assembled state of the device and as a result to be pressed against at least one portion of said first clamping member so that this is pressed in the direction of the upright and the scaffold element is pressed in the opposite direction.

In accordance with another feature of the present invention, the first clamping member comprises upper and lower clamping surfaces of which the upper clamping surfaces are adapted to bear against the wall of the upright above the engagement member while the lower clamping surfaces are adapted to bear against the wall of the upright below the engagement member. In accordance with a further feature of the present invention, the second clamping member consists of a unit mounted eccentrically around a pin in the scaffold element with a curved clamping surface which is adapted to cooperate with an associated edge surface on said first clamping member so that this is pressed by means of the clamping surface into locking position of said second clamping member but can be removed down by means of a pivotal movement round the pin for release of said first clamping member.

The invention will in the following be further described in an embodiment with reference to the enclosed drawings, in which Fig. 1 is a lateral view of the coupling device according to the invention in a connected condition, Figs. 2 and 3 is a lateral view and a plan view respectively of a hook-up member included in the coupling device, Fig. 4 is a plan view of a bowl-shaped engagement member included in the coupling device, Fig. 5 and 6 is a lateral view and an end view respectively of a clamping member included in the coupling device. Figs. 7, 8, 9 and 10 show locking wedges included in the coupling device, Fig. 11 is a central cross section through the coupling device in a released condition, Fig. 12 is a corresponding section through the coupling device in a locked condition at a first cross dimension of the upright, Fig. 13 is a corresponding section through the coupling device in a locked condition at an upright with a second cross dimension and Fig. 14 is an example of a scaffold with coupling devices according to the invention.

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The main parts of the coupling device according to the invention are apparent from Fig. 1 which is a lateral view. Therefrom it is apparent that the coupling device 1 according to the invention includes an engagement member 2 which in the shown embodiment is designed

as a substantially bowl shaped member which is connected to an upright 3 included in a scaffold or similar. The bowl shaped member 2 extends around the whole periphery of the upright 3 and forms a substantially rotational symmetrical body which delimits a space 4 between the cylindrical wall 5 of the upright and the peripheral wall 6 of the bowl shaped member 2 (see Fig. 4). In the shown embodiment the bowl shaped member is fixed to the upright by means of for example welding and is between the fixations 7 provided with drainage openings 8 for the discharge of water, rubbish and the like. These drainage openings can also be used as cleaning holes, in which case larger objects can easily be poked out by means of a screwdriver or the like which is introduced into the openings from below. The coupling device 1 according to the invention further comprises a hook-up member 9 which projects from an end portion 10 of a scaffold element 11. The scaffold element 11 consists for example of an elongated horizontal tubular member which is included in a scaffold 12 which is shown by an example in Fig. 14. The coupling device 1 further comprises a clamping member, in the following called a locking clamp 14 which is arranged in a locking condition of the coupling device to be pressed against the upright 3 above as well as below the bowl shaped engagement member 2. A wedge shaped member 15 in the form of two locking wedges 16, 17 is disclosed and provided to press the locking clamp 14 against the upright.

The hook-up member 9 is designed in accordance with Fig. 2 and 3 from which it is apparent that the hook-up member has a hook shaped portion 18 with a recess 19 and an inner support surface 20. The hook shaped portion 18 has in its surface faced towards the recess 19 a shape which suitably is adapted to the shape of the inwards faced wall 6 of the bowl shaped engagement member. The hook-up member 9 has a concave surface 21 which primarily from considerations of space is adapted to the shape of the upright 3 but which however not in the normal case consists of any contact surface against the upright. A substantially cylindrical portion 22 is provided to project into the horizontal scaffold element 11 and exhibits grooves which allow a safe connection to the scaffold element 11 by providing same with embossings 13, see Fig. 1.

The hook-up member 9 is further provided with a fully penetrating flute 24 which debouches in the topside 25 and the underside 26 of the hook-up member 9. Grooves 27, 28 with wedge shaped cross-sections are arranged in the flute 24 along two opposite walls, said grooves extending over the main part of its length from its underside 26 of the hook-up member and upwards substantially parallel to each other but diverge from each other with an oblique top portion 29. The grooves 27 and 28 are provided to guide the two locking wedges 16, 17 in a way which will be further described below.

The flute 24 is further provided with a clamping surface 30 which likewise extends from the underside of the hook-up member 9 to its topside 25 and is provided to cooperate with the locking wedges which likewise will be closer described below. With dotted and dashed lines the position of the locking wedges 16, 17 close to each other in the flute 24 is indicated in Fig. 3.

In Figs. 5 and 6 an example of the design of the locking clamp 14 is further shown. The locking clamp 14 is to be brought onto the hook-up member 9 which then will extend through an opening 31 of the locking clamp which is able to be displaced along the hook-up member in the released position of the coupling device. A stop-pin 32 (see for example Figs. 2 and 3) will prevent that the locking clamp is removed unintentionally. The locking clamp is provided with a top and a bottom front clamping surface 33, 34 which are provided to be placed into contact with the upright and has therefore a shape of concave cylindrical envelope surface which is adapted to the shape of the wall of the upright. The locking clamp 14 is provided with a top and a bottom, rear clamping surface 35, 36 which is to cooperate with the locking wedges 16, 17 in a way which will be further described below. The upwards faced surfaces form support surfaces 57, 58 for the locking wedges 16, 17.

The design of the locking wedges 16, 17 is shown by means of an example in Fig. 7-10. The locking wedge 16 has a first clamping side 37 which is to be placed into contact with the clamping surface 30 of the hook-up member 9 and a second clamping surface 38 which is to be placed into contact with the locking clamp 14. The locking wedge 17 has correspondingly a first clamping side 39 which is to

be placed into contact with the clamping surface 30 of the hook-up member 9 and a second clamping side 40 which is to be placed into contact with the locking clamp 14.

In accordance with the present invention the two locking wedges 16, 17 has relatively to each other different distances between their first and second clamping side at corresponding locations, namely so that the locking wedge 16 has a larger distance between operating portions of its first and its second clamping side than the corresponding distance at the other locking wedge 17. The two locking wedges 16, 17 have a stepwise decreasing wedge shape so, that the second clamping side 38 of the locking wedge 16 has a top oblique clamping surface 41 which is to cooperate with the top, rear clamping surface 35 of the locking clamp 14 and a bottom oblique clamping surface 42 which is to cooperate with the bottom rear clamping surface 36 of the locking clamp 14. The clamping surfaces of the locking clamp are oblique in correspondence with the clamping surfaces of the locking wedge. Between the top and bottom clamping surface 41, 42 of the locking wedge 16 a top shoulder surface 43 is provided.

The second locking wedge 17 has likewise a top clamping surface 44, provided to cooperate with the top rear clamping surface 35 of the locking clamp 14 and a bottom clamping surface 45, provided to cooperate with the bottom rear clamping surface 36 of the locking clamp. Between the top and the bottom clamping surface 44, 45 a top shoulder surface 46 for the locking wedge 17 is provided. The different distances between the first and second clamping sides 37, 39 and 38, 40 respectively involves therein, that the distance between the first clamping side 37 and the top clamping surface 41 of the locking wedge 16 is larger than the distance between the first clamping side 39 and the top clamping surface 44 of the other locking wedge 17. The distance between the first clamping side 37 and the bottom clamping surface 42 of the locking wedge 16 is larger than the distance between the first clamping side 39 and the bottom clamping surface 40 of the other locking wedge 17. The top clamping surface 41 of the wedge 16 continues over an intermediate shoulder surface 47 with a surface 48, the distance of which to the clamping side 37 is equal to the corresponding distance at the bottom clamping surface 45 of the other locking wedge 17, that is to say that the locking wedges

have a bottom portion with the same dimensions. However, that surface 48 does not form any clamping surface for the locking wedge 16. By the stepwise shape of the wedges there is formed a head 49, on the upper side of which a striking surface is obtained, against which the locking wedges can be struck down by means of a tool.

Each one of the two locking wedges 16, 17 has with reference to Figs. 8 and 10 a ledge 50, 51 which extends over the whole height of the locking wedges and has a wedge shaped cross section. The ledge 50, 51 has at the top an extended portion 52, 53. The two ledges 50, 51 act as guides for the wedges and are provided to be displaced in the two wedge shaped grooves 27, 28 in the flute 24 of the hook-up member 9. By means of the extended portions 52, 53 there is prevented that the wedges fall down through the flute 24. They will furthermore result in a larger striking surface for the striking down of the locking wedges. By means of a portion 54 which is located at the bottom of each one of the locking wedges 16, 17 and which is directed laterally after having the locking wedges positioned in the flute, there will be secured, that the wedges cannot be lifted completely out of the flute 24.

With reference to Figs. 11, 12, 13 the operation of the coupling device will be described. As mentioned above the object of the present invention is besides to obtain a stabile connection, easy to handle, also to enable an adaption of the coupling device to different cross dimensions of uprights. The coupling device is shown in Fig. 11 in its released condition in an example of connection with a large diameter of the upright, and with a fixed outer dimension of the bowl shaped member 2. The coupling device is shown in Fig. 12 in a locked condition in an example with said large diameter of the upright, whereas Fig. 13 shows the coupling device in a locked condition in an example with a smaller diameter of the upright. It is apparent from Fig. 11 that the scaffold element 11 is supported by the fact that the hook-up member 9 rests by means of its hook shaped portion 18 in the bowl shaped engagement member 2 also when the coupling device is in its released condition. The hook-up member 9 rests in the shown example by means of its inner support surface 20 against the upper edge portion of the engagement member 2. In this condition the two locking wedges 16, 17 are retracted upwards to a releasing position so, that

the locking clamp 14 is permitted to be displaced maximally in direction from the upright 3. In this connection the underside 55, 56 of the two locking wedges 16, 17 form bottom shoulder surfaces, resting against the upwards faced support surface 57 of the locking clamp. With the locking device released, that is to say with the locking wedges 16, 17 retracted upwards and the locking clamp 14 removed to the position shown in Fig. 11, the hook-up member 9 and consequently the whole scaffold element 11 can be lifted up from the bowl shaped engagement member 2 and the scaffold element 11 can be removed from the upright 3.

When the coupling device is to be utilized for connection with an upright with said large diameter, the hook-up member 9 will be hooked into the engagement member 2. At this moment there is provided that the coupling device has taken the position shown in Fig. 11 with the locking wedges 16, 17 retracted and the locking clamp 14 removed. Then the locking clamp 14 is brought forwards against the upright 3 so, that its front clamping surfaces 33, 34 are placed into contact with the cylindrical wall of the upright. Then a space is established between the rear clamping surfaces 35, 36 of the locking clamp 14 and the clamping surface 30 of the flute which corresponds to the above described distance between the first and second clamping sides 39, 40 of one of the wedges, namely the locking wedge 17. As the connection is present with an upright with the large diameter within a predetermined dimension interwall said space will be comparatively less than in the example with the small diameter. Hereby the present locking wedge 17 will consequently fall down a bit through the flute 24 to an operative locking position so, that its top clamping surface 44 will be brought into contact with the top, rear clamping surface 34 of the locking clamp 14 and the rear clamping surface 45 of the locking wedge will be brought into contact with the bottom rear clamping surface 36, of the locking clamp. Because of the relatively larger dimensions of the locking clamp 16 this one will remain in an upper, inoperative position with its shoulder surfaces 43, 47 resting against upwards faced support surfaces 57, 58 of the locking clamp 14. Because of that the locking wedge 16 is positioned at a higher level than the other locking wedge 17, the bottom surface 48 of the latter will be positioned inside the clamping surface 45 of the

locking wedge and will in that way not be operative as clamping surface. The operative locking wedge 17 will be struck down a bit further into the flute 24 with strikes by means of a suitable tool, a hammer or the like, against the upper side of the head 29 of the locking wedge. This causes the locking clamp 14 to be pressed against the upright by wedge action at the same time as the hook-up member 9 with its hook shaped portion 18 is pressed against the innerwall 6 of the bowl shaped member 2. Besides the pressing of the locking wedge 17 against the locking clamp 14 a pressing action of the locking wedge takes place with its first clamping side 39 against the clamping surface 30 of the flute 24. A certain force reception takes possibly also place in the groove 28 unless it is dimensioned with a large play. It is apparent from Fig. 12 that none of the locking wedges 16, 17 will project in a disturbing manner above the scaffold element 11 and support elements or similar can therefore be placed above the scaffold element 11 and extend fully up to the upright 3. At the bottom the operative locking wedge projects downwards a bit below the wedge 16 and can for the purpose of disassembling simply be struck upwards by means of a struck against the underside of the locking wedge. Then the locking clamp 14 can again be removed and the coupling device be released.

In the example with connection with an upright 3 having an comparatively less diameter (see Fig. 13) the hooking up is arranged in the same way as in the preceding example. However there is obtained such a large space in the flute 24 between the rear clamping surfaces 35, 36 of the locking clamp 14 and the clamping surface 30 of the flute, that both locking wedges 16, 17 fall down. Because of the less dimensions of the locking wedge 17 the same will however be completely inoperative and is kept in place by means of its guidance with its ledge 51 in the groove 58 and by means of the extended portion 53 of the ledge. The locking wedge is in one aspect operative in such a way, that it forms transversely a complementing member in the flute 24, so that the operative wedge 16 will not be obliquely positioned. In this case the distance between the rear clamping surfaces 35, 36 of the locking clamp 14 and the clamping surface 30 of the flute will consequently at a predetermined dimension interval for the outer diameter of the upright 3 be in correspondence with

the distance between the top and the bottom surface 41, 42 of the locking wedge 16 on one hand and the first clamping side 37 on the other hand. This results in that the top and bottom clamping surface 41, 42 of the locking wedge 16 will be brought into contact with the top and the bottom rear clamping surface 36, 37 of the locking clamp 14 whereas the first clamping side 37 of the locking clamp will be pressed against the clamping surface 30 of the flute 24. It is essential that the locking wedge 16 in this position will be positioned with its striking surface above the locking wedge 17, so that the locking wedge 16 can be struck downwards by means of strikes on its top side. Then the locking clamp will by means of its front clamping surfaces 33, 34 be pressed against the upright and the hook-up member 9 will be pressed in direction from the upright and be pressed with its hook shaped portion 18 against the innerwall 6 of the bowl shaped member 2.

In the assembled state of the coupling device, that is to say in its locking position, a very stiff coupling is obtained as a result of the fact that not only radially directed or axially directed forces in relation to the upright are taken up but also to a large extent breaking forces which tend to turn the transverse scaffold element 11 into different angular positions in relation to the upright. Release of the coupling device is obtained also in this case by means of strikes from below against the underside of the wedges, whereafter the locking clamp 14 can be removed and the scaffold element 11 can be lifted off.

Fig. 14 shows an example of a scaffold 12, provided with coupling devices 1 according to the invention. The uprights 3 can thus be provided along their length with bowl shaped members 2 with even spacing apart, while the transverse scaffold elements 11 each comprise said end portions 10, provided with the hook-shaped members 9 at each of their two ends. As a result of the rigidity which is achieved by means of the coupling device according to the invention, such a scaffold can be lifted, for example by a crane and displaced while retaining its correct shape. For example a scaffold, for example in the form of a lift tower, can be built lying down and then be raised by means of a crane to the upright position of use.

One important feature the present invention is that the end of the horizontal scaffold element, that is to say the hook-shaped member 9 is not pressed against the upright to bear against this but instead away from the upright towards the wall 6 of the bowl shaped member 2. As a result one and the same centre spacing between the uprights can be maintained with uprights with different diameters but with one and the same spacing between the axial centre and the wall 6 of the bowl-shaped member. This is a great advantage when a scaffold is built up of telescopic uprights that is to say where the upper upright with a smaller dimension is coupled telescopically to lower uprights with larger dimensions.

The invention is not limited to the examples of embodiment described above and shown on the drawings but can be varied within the scope of the following claims. The scaffold can support person 11 to make working places available or support building constructions, such as cast concrete. The scaffold can also be a combination thereof. Furthermore, the bowl shaped member may have another shape, for example it may be made with a plane shell wall and a plane bottom. The bottom can be perforated to a greater or lesser extent, for example the bottom can be replaced by spacing members which support the wall 6.

It is also conceivable for the bowl-shaped member to be replaced by a plurality of yokes determining the maximum number of scaffold elements 11 so that the continuous wall 6 extending with spacing from the upright is replaced by a plurality of separate walls, one for each yoke. The yokes can be formed as U-iron for example. Likewise, both the hook-shaped member 9 and the clamping member 14 can have a completely different shape. The four clamping surfaces can be replaced by an upper and a lower wider coherent clamping surface for example. The clamping member may possibly comprise clamping surfaces adapted to bear against the upright only at one side of the bowl shaped member, and the clamping member may be movably, for example, pivotally, anchored in the end portion of the scaffold element 11. Said first clamping member may be in two parts, in which case the lower part which forms the lower clamping surface can be displaceable in a groove in the longitudinal direction of the scaffold element and be adapted to be located in a clamping position.

by said other clamping member, for example a wedge. A threaded nut on the scaffold element can be used as the second clamping member which can be displaced axially by turning about this and press said first clamping member against the upright. The nut can be replaced by another element which can be turned axially round the scaffold element, for example a bevelled length of tube which, on turning, presses the first clamping member against the upright. The scaffold element 11 may, instead of a transverse strut, consist of a bracket for example to support wings such as planks or the like or a vertical guide for a lift.

It is conceivable that the principle with the double locking wedges with different dimensions also can be utilized for such coupling devices which are provided to press the hook-up member in direction from the upright. In such cases the locking clamp 14 thus can be deleted and the wedges be positioned in a space between the wall of the upright 3 and the hook-up member. The principle can further be utilized by coupling devices of such type where the hook-up member is pressed to contact with the wall of the upright 3 by the wedges being inserted between the hook-shaped portion and the inwards faced wall of the bowl shaped member. In that case the bowl shaped member can for example be open in direction downwards, so that the wedges are allowed to project below the bowl shaped portion. The bowl shaped portion can be replaced with a tubular piece which is connected to the upright 3 by means of distance elements. Even though there is only shown one hook-up member for the engagement member 2 the coupling devices are provided to enable connection of a plurality of hook-up portions, that is to say ends of scaffold elements with one and the same engagement element 2 for example having between one and eight hook-up members connected with one and the same engagement member. With scaffold is meant every kind of a stage which can be utilized in connection with building, repairing and maintenance of works. The scaffold can be provided to carry working personal in order to enable availability to different working places.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. Scaffold means comprising a coupling device for coupling together a laterally directed scaffold element to an upright, wherein the coupling device includes an engagement member which in use is connected to the upright and is open upwards, said engagement member comprising a wall which extends with spacing from the upright and which delimits a space situated between the upright and the wall, a hook member disposed at least at one end of the scaffold element and adapted to hook into the engagement member, a first clamping member which is movable in relation to the scaffold element and the hook member and which comprises one or more clamping surfaces, said first clamping member being arranged so that in use at least one of its clamping surfaces bears against the upright, and a second clamping member which is adjustable between a release position and a locking position and which is adapted, in the locking position, to be forcibly gripped between the first clamping member and the scaffold element so that the first clamping member is pressed towards the upright and the scaffold element is pressed generally horizontally away from the upright whereby the scaffold element is clamped by means of the hook-up member to the engagement member.

2. Scaffold means as claimed in claim 1, wherein the scaffold element comprises a transverse slot and said second clamping member consists of a wedge member which is adapted to be introduced into the slot in the assembled state of the device and as a result to be pressed against at least one portion of said first clamping member so that this is pressed in the direction of the upright and the scaffold element is pressed in the opposite direction.

3. Scaffold means as claimed in claim 1 or 2, wherein said first clamping member comprises upper and lower clamping surfaces of which the upper clamping surfaces are

adapted to bear against the wall of the upright above the engagement member while the lower clamping surfaces are adapted to bear against the wall of the upright below the engagement member.

4. Scaffold means as claimed in claim 1 or 2, wherein said first clamping member is provided with an opening through which the hook-up member extends.

5. Scaffold means as claimed in claim 1 or 2, wherein the wall of the engagement member and said intervening space extend round the periphery of the upright and are common to a plurality of scaffold elements.

6. Scaffold means as claimed in claim 1 or 2, wherein the wall of the engagement member and said intervening space extend round the periphery of the upright and are common to a plurality of scaffold elements, the engagement member being substantially bowl-shaped.

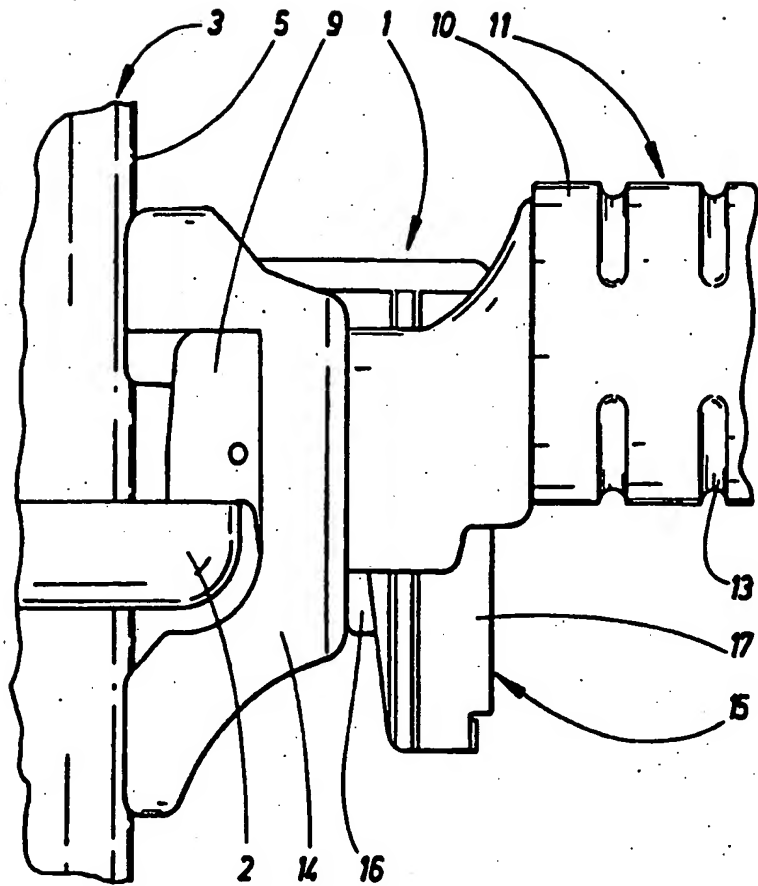
7. Scaffold means as claimed in claim 1 or 2, wherein said first clamping member comprises upper and lower clamping surfaces of which the upper clamping surfaces are adapted to bear against the wall of the upright above the engagement member while the lower clamping surfaces are adapted to bear against the wall of the upright below the engagement member, the wall of the engagement member being cylindrical.

8. Scaffold means as claimed in claim 1 or 2, wherein the wall of the engagement member and said intervening space extend round the periphery of the upright and are common to a plurality of scaffold elements, the engagement member being substantially bowl-shaped, said bowl-shaped engagement member being provided with recesses positioned at the bottom.

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9. Scaffold means as claimed in claim 1, wherein said second clamping member consists of a unit mounted eccentrically round a pin in the scaffold element with a curved clamping surface which is adapted to cooperate with an associated edge surface on said first clamping member so that this is pressed by means of the clamping surface into locking position of said second clamping member but can be removed down by means of a pivotal movement round the pin for release of said first clamping member.

FIG. 1*Gowling & Henderson*

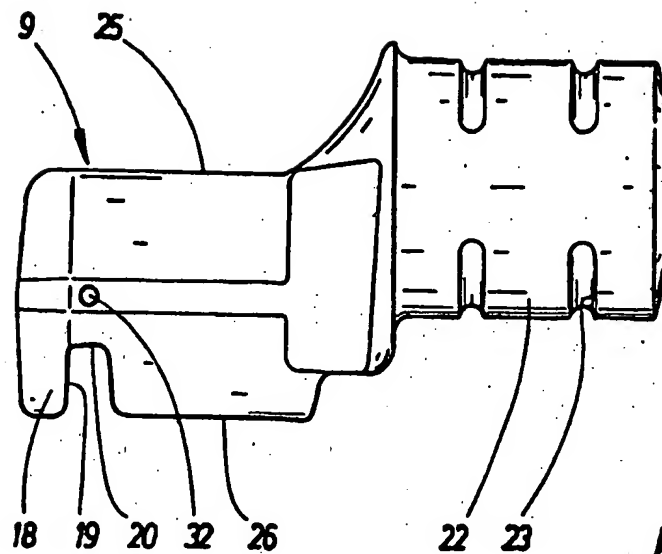


FIG. 2

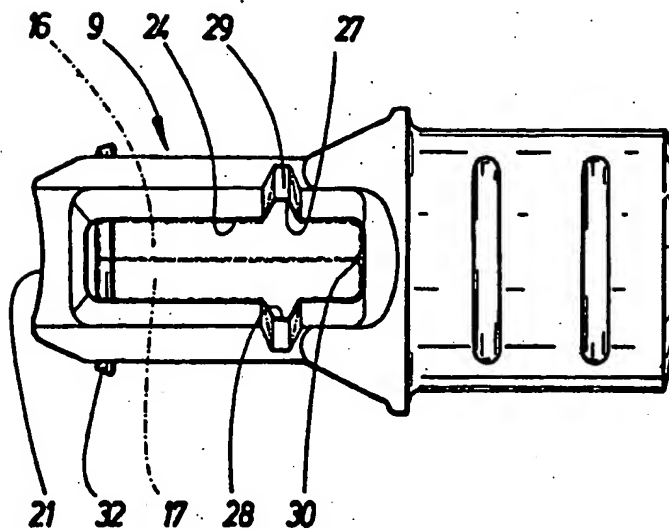
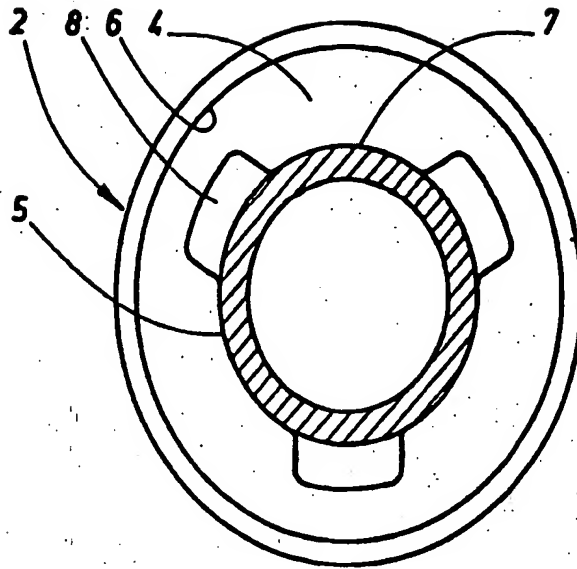
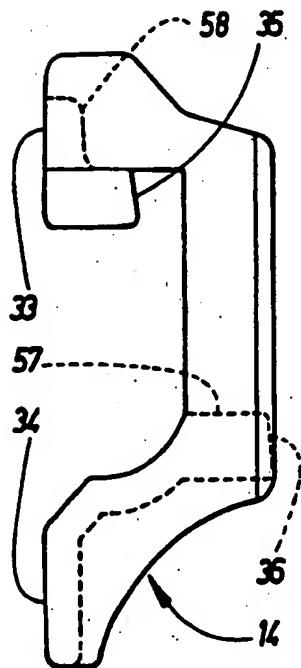
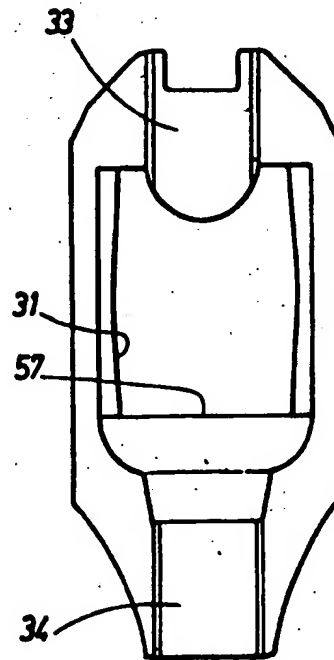


FIG. 3

FIG. 4FIG. 5FIG. 6*Gowling & Henderson*

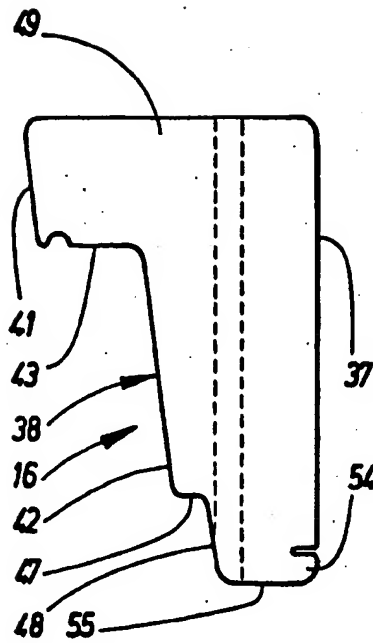


FIG. 7

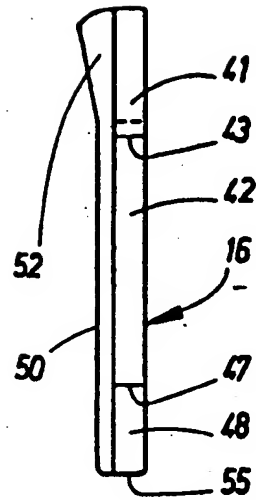


FIG. 8

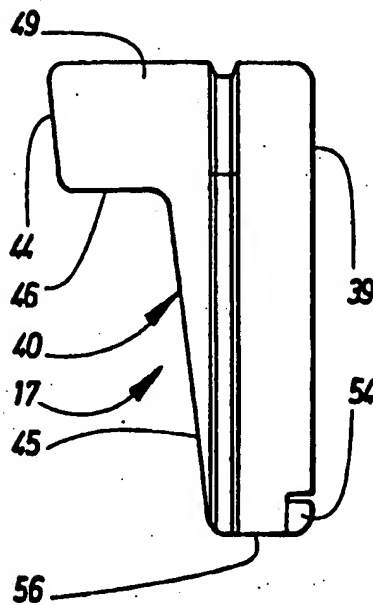


FIG. 9

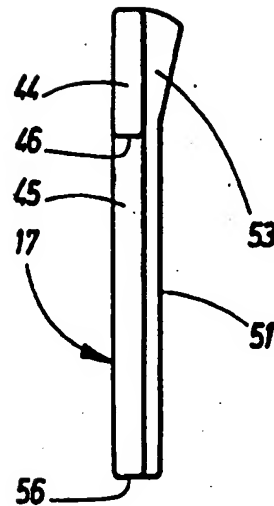
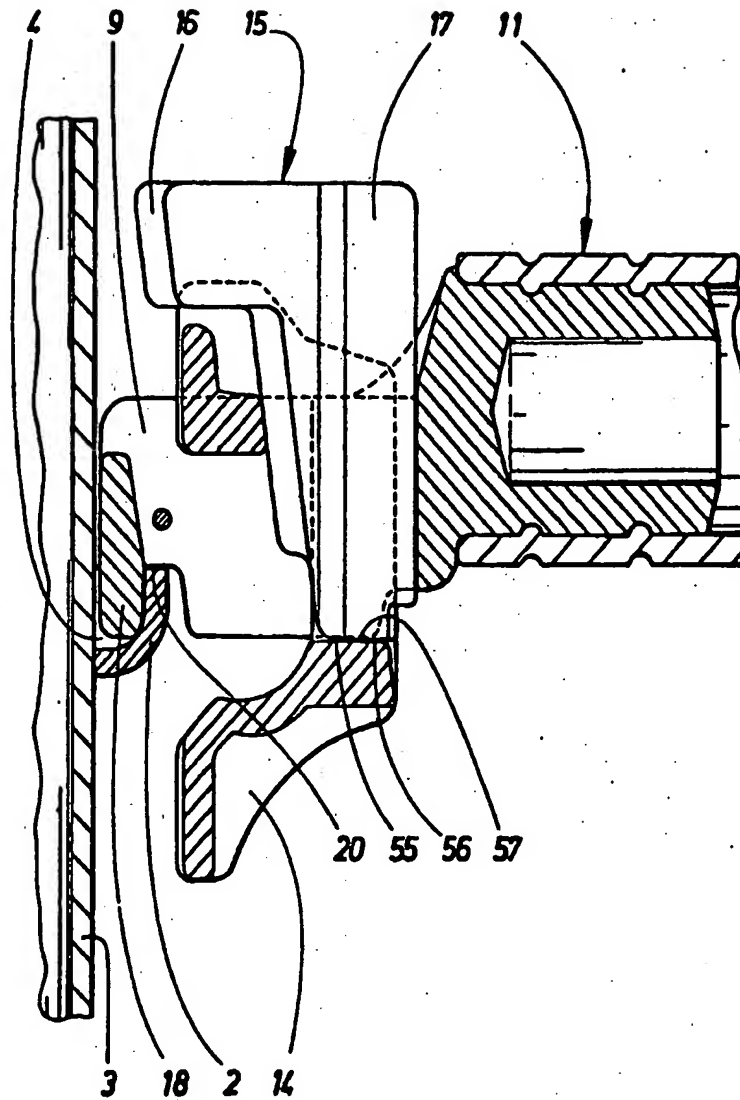
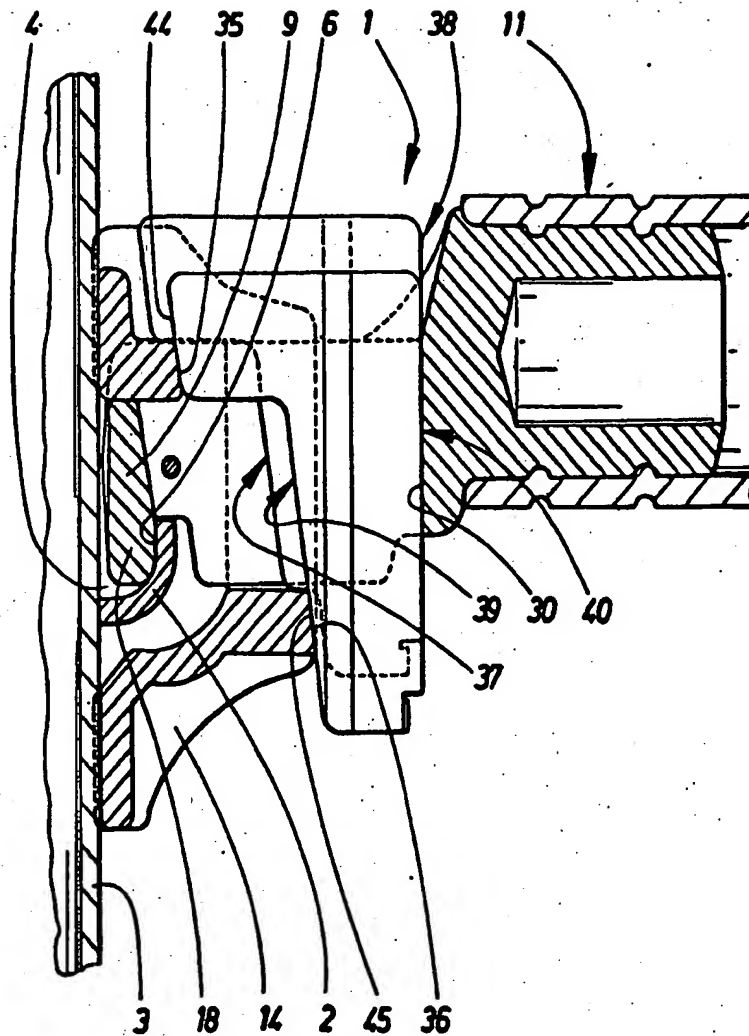
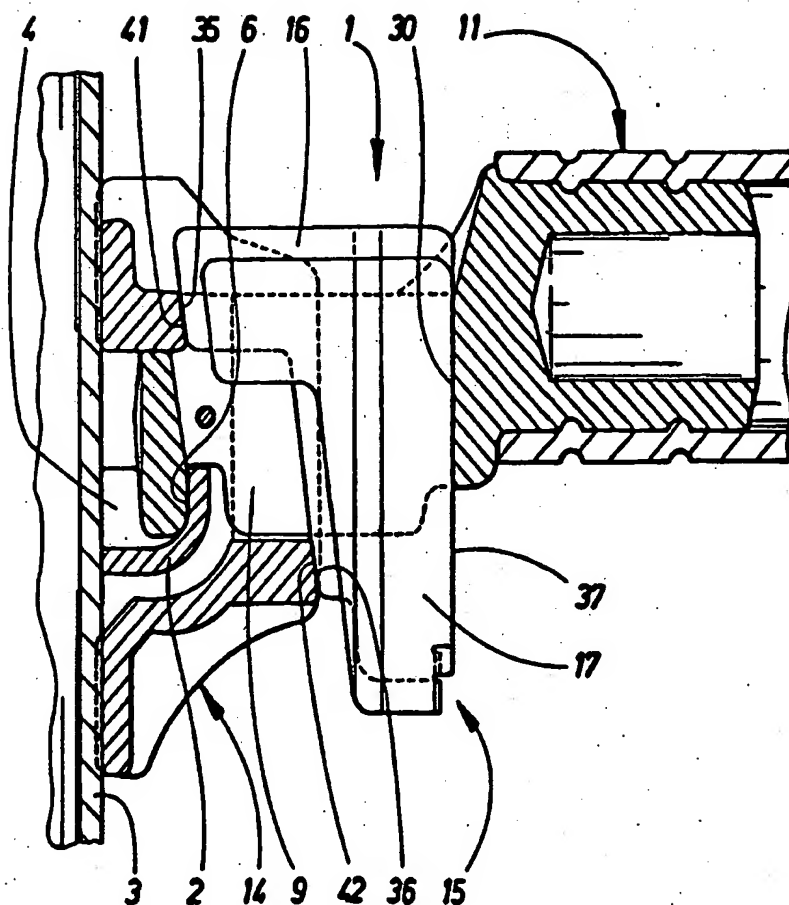


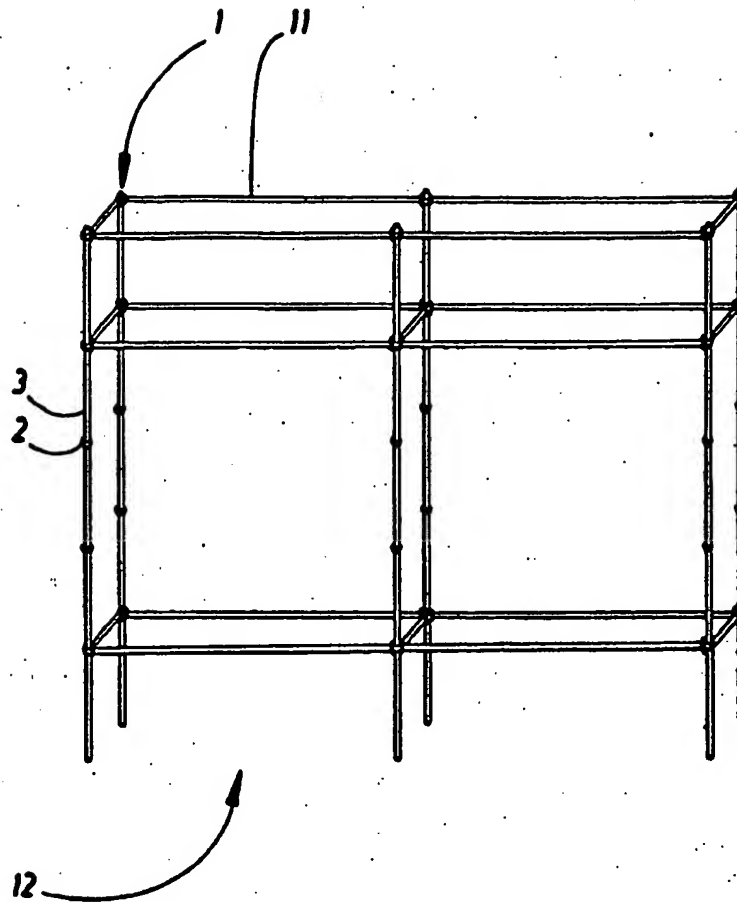
FIG. 10

Coulting & Henderson

**FIG. 11***Gowling & Henderson*

FIG. 12*Gowling & Henderson*

**FIG. 13***Gonling & Henderson*

FIG. 14*Cowling & Henderson*

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